MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2019/2020

EET2166 – INTRODUCTION TO ELECTRICAL POWER AND MACHINES

(ME)

21 OCTOBER 2019
2:30 p.m. – 4:30 p.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 4 pages including cover page with 4 questions only.
2. Answer **ALL** questions. The distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided.
4. All necessary working **MUST** be shown.

Question 1

(a) A three-phase 440V power generator is connected to three impedances, each with $Z\emptyset = 6 + j8\ \Omega$ are Δ-connected, as shown in Figure Q1. Find phase current, line current, total active power, total reactive power, total apparent power and the power factor of this load. [10 marks]

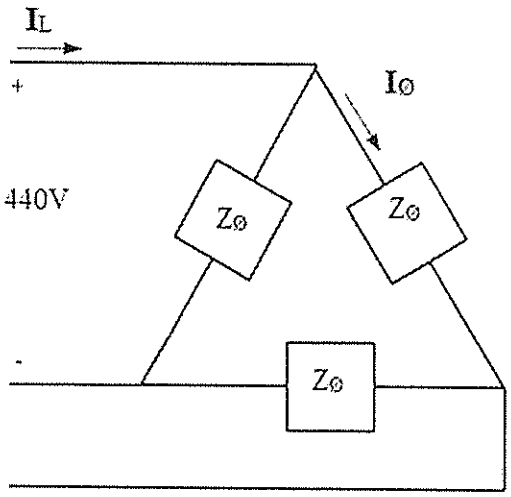

Figure Q1

(b) A DC shunt generator with terminal voltage of 240V delivers a load current of 160A. The armature and shunt field resistances are 0.02Ω and 60Ω, respectively.

(i) Draw and label the equivalent circuit of the generator. [2 marks]

(ii) Calculate the shunt field current, [2 marks]

(iii) the armature current, [2 marks]

(iv) the generated emf in armature, and [2 marks]

(v) the load resistance. [2 marks]

Question 2

(a) A 220V, 1.5kW, 859 rpm, separately excited DC motor has armature resistance of 2.5Ω and it draws a current of 8A at rated load condition. If the field current and the armature current are fixed at the value of rated speed at rated load, what will be the no load speed of the motor? Assume losses remain constant between no-load and full-load operation. [7 marks]

(b) The equivalent impedance referred to the primary of a 2300/230 V, 500KVA, single-phase transformer is , Z_{eq}= 0.2+j0.6Ω.

(i) Calculate the voltage regulation when the transformer delivers rated capacity at 0.8 pf lagging at rated secondary voltage. [7 marks]

(ii) Find the efficiency of the transformer at rated condition given that magnetizing components, R_o = 120kΩ and X_o =50kΩ. [5 marks]

(c) Three single-phase transformers rated at 150KVA, 3000V/300V, 50Hz, are connected in wye-delta on a 6250V, three- phase line. Draw the wye- delta connected three-phase transformer. [3 marks]

If the load is 150KVA, calculate the following currents:

(i) In the incoming and outgoing transmission lines [4 marks]

(ii) In the primary and secondary windings [4 marks]

Question 3

(a) A 3 phase 4-pole induction motor is supplied from 3 phase 50Hz ac supply used as conveyor motor in manufacturing production line and drawing a 100kW from the 3 phase supply. If given the copper losses and iron losses in the stator is 10kW and friction losses are 5 kW. Find:

(i) The synchronous speed. [1 mark]

(ii) The rotor speed when slip is 5%. [1 mark]

(iii) The active power to the rotor. [1 mark]

(iv) The rotor copper losses. [1 mark]

(v) Mechanical power developed. [2 marks]

(vi) Mechanical powers deliver to the load, (P_{out}) [2 marks]

(vii) The mechanical torque developed. [2 marks]

(viii) The motor efficiency. [2 marks]

Continued...

(b) A three-phase, star connected alternator is rated at 1500kVA, 11kV. The armature effective resistance and synchronous reactance are 1.2Ω and 24Ω respectively. Calculate the percentage regulation for a load of 1200kW at

(i) 30° lagging, [4 marks]

(ii) unity, and [4 marks]

(iii) 30° leading. [4 marks]

(c) What are the differences between induction motor and synchronous motor in terms of starting, speed and power factor. [6 marks]

Question 4

(a) Explain how hydroelectric power plant works with the aid of diagram. Also, discuss the impacts of a hydroelectric power plant. [11 marks]

(b) Figure Q4 shows a three-line network. The load currents and the fault levels at various locations are indicated in the figure. The operation time of both the CBs is 0.4 s. The IDMT relay characteristic in terms of PSM is shown in Table Q4. Assume the pickup current of relay is set to 1.5 A, the TMS for Relay 1 is 0.1 and the ratio of current transformer as below

CT ratio for relay $R_1 = A_1 = 100/1$; CT ratio for relay $R_2 = A_2 = 200/1$

Determine,

(i) the TMS value for Relay 2 if fault of 3000A detected at Bus C, and [6 marks]

(ii) the actual operating time of Relay 2 if fault of 4800A found at Bus B. [3 marks]

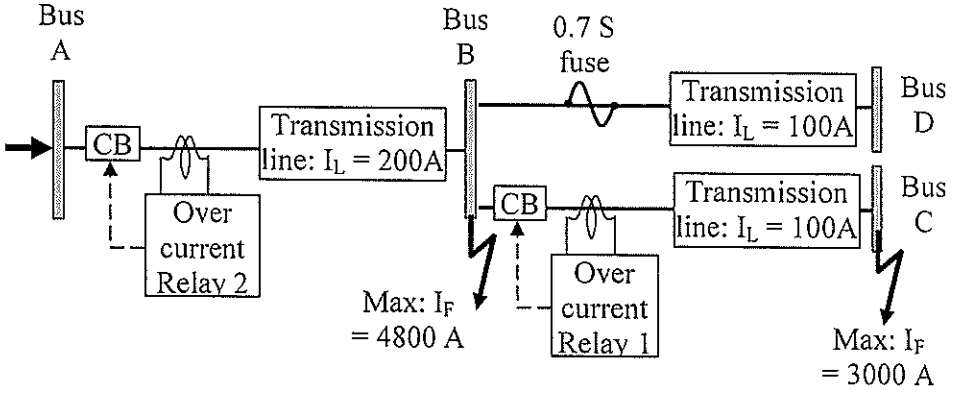

Figure Q4

Table Q4

PSM	20	18	16	14	12	10
T (sec)	2.2	2.6	2.8	3.0	3.2	3.5

$(Relay\ operating\ time = T \times TMS)$

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